DESIGN AND FABRICATION OF MACRO CHANNEL HEAT SINK FOR BATTERY PACK EV APPLICATIONS

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Introduction:

1. The electric vehicles are growing fast and this means we need to find better ways to keep the batteries from getting too hot. The lithium-ion batteries, the NMC 811 type get very hot when they are being charged or used. If we do not keep this heat under control the batteries will not work well and they will not last as long. They can even be dangerous. So it is very important to keep the batteries at the temperature.
2. This project is about making a part to help keep the batteries cool. We want to make a -channel heat sink that can be used in the battery packs of electric vehicles. Our system is designed to help get rid of the heat and keep all the battery cells at the temperature. We are using a design with curves to make the coolant flow better and prevent hot spots.
3. We have chosen Aluminium Nitride as the material to help keep the heat from causing problems. It is very good at letting heat pass through. It is also a good insulator. We are using a mixture of glycerol and water as the coolant because it can absorb heat well. It is stable.
4. We used computer modelling to design our system. We tested it using special analysis tools. We looked at how the temperature's distributed how much pressure is lost and how well the heat is transferred. We also thought about how our system can be made using machines or 3D printing.
5. Overall, we want to make a cooling system that works well is safe and is practical for the batteries in electric vehicles. We want the electric vehicles to have batteries that work well and last a long time. The electric vehicles need batteries and our project is, about making that happen.

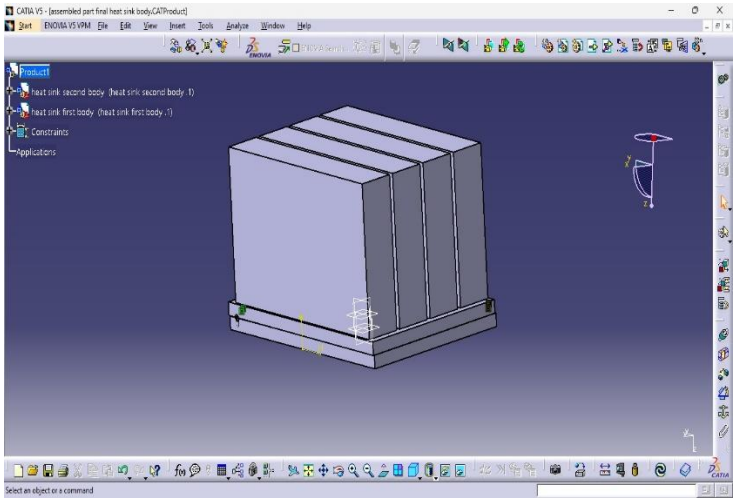

Figure 1: 3D Model of Heat Sink

Objectives:

1. To select a suitable dielectric material that allows heat transfer while preventing electrical conduction.
2. Creating a heat sink that efficiently cools electronic parts is the goal.
3. To ensure electrical safety by maintaining insulation between components and the heat dissipation path.

Methodology:

The methodology of the project happens step by step as below:

1. The project starts with identifying thermal issues in EV battery packs and selecting materials like Aluminium Nitride for efficient heat transfer and insulation.
2. A macro-channel heat sink with serpentine channels is designed using CAD software (Fusion 360).
3. Thermal and CFD analysis is carried out in ANSYS to study temperature distribution, flow behaviour, and pressure drop.
4. Finally, experimental testing is performed to evaluate cooling performance and validate the results with simulation.
5. The designed model is then fabricated using methods such as CNC machining or 3D printing to develop a working prototype.

Result and Conclusion:

Result:

1. The macro-channel heat sinks effectively reduced battery temperature and minimized hotspots.
2. Uniform temperature distribution was achieved across all battery cells.
3. The system showed low pressure drop and efficient coolant flow performance.

Conclusion:

The project successfully developed an efficient macro-channel heat sink for EV battery cooling. The use of Aluminium Nitride ensured both high thermal conductivity and electrical safety. The serpentine channel design improved heat transfer and coolant distribution. Overall, the system provides a reliable and practical solution for battery thermal management in EV applications.

References:

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Future Scope:

The future scope of this project includes:

1. Implementation of coolants like nanofluids to further improve heat transfer performance.
2. Optimization of channel geometry using AI or advanced CFD techniques for improved efficiency.
3. Integration of real-time temperature monitoring and smart control systems in EV battery packs.
4. Experimental testing under real driving conditions and scaling the design for commercial EV applications.